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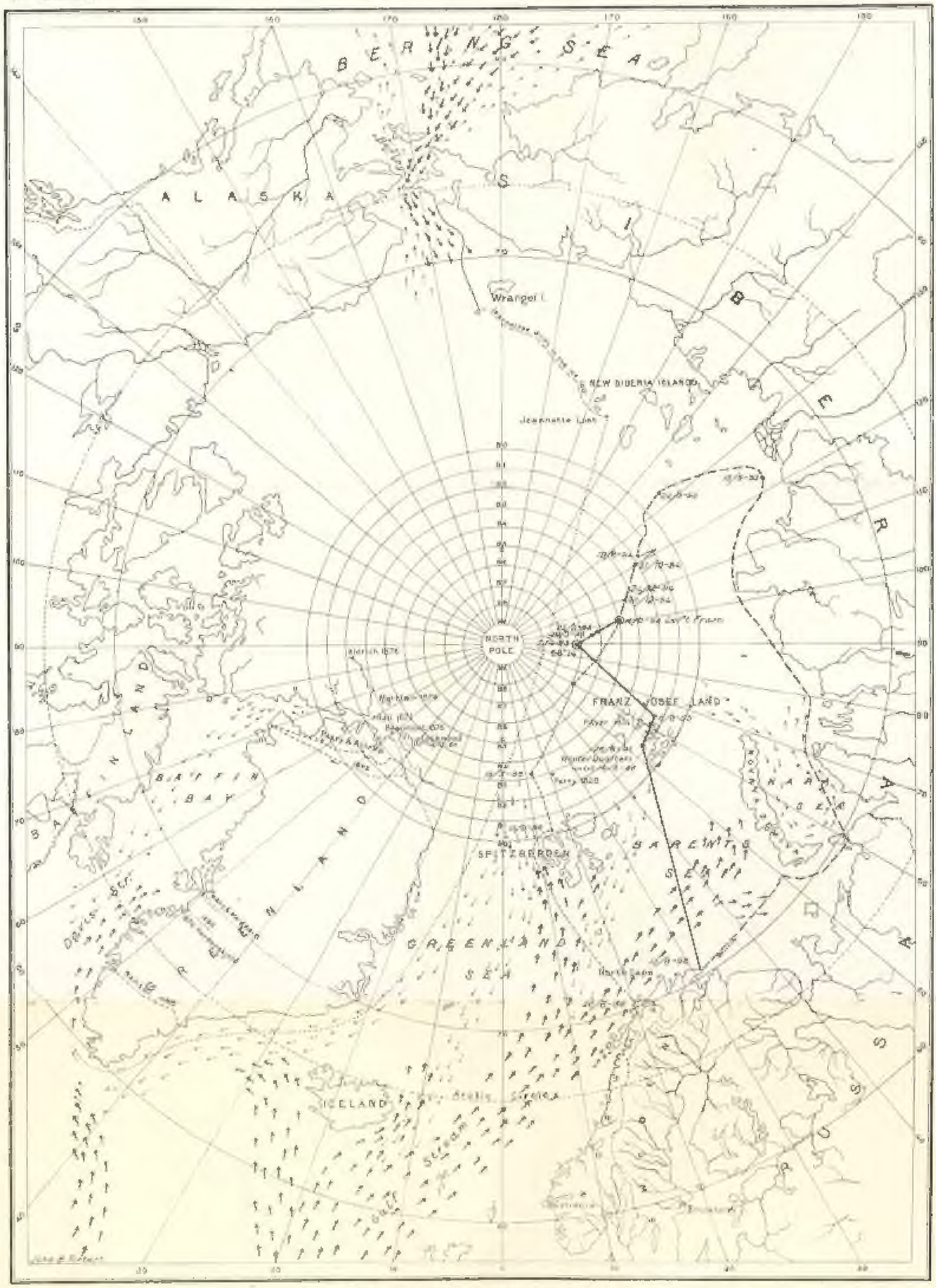

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THE

National Geographic Magazine

Vol. VII OCTOBER, 1896 No. 10

CALIFORNIA

By the Hon. George C. Perkins,

United States Senator

The Californian is never at a loss for some good words for his state. If he is a pioneer he has wrought at the foundations and rejoices in the rise and progress of a commonwealth having now more than fourteen hundred thousand people. The Argonaut did not much concern himself with the geographical greatness of the future state. He did not even know that there would be a state. There was the great outlying territory of Alta California, stretching along for more than nine degrees of latitude and broadening inland to the crests of the Sierra 250 miles or more, an area that today contains 156,000 square miles, or more than 99,000,000 acres, constituting the second largest state in the Union. He knew little of the coastline, with its indentations a thousand miles in extent, as he sailed into that magnificent bay after his voyage around cape Horn, and he knew less if, after the long trail overland, he looked down from the top of the Sierra on the great valleys that lay between the mountains and the ocean.

The Spanish dominion, which lasted for 53 years, did not concern him much, since it left few vestiges of civilization. Mexican rule in Alta California was little more than a continuation of that of the mother country. The missions founded by the Catholic fathers constituted a chain of settlements from the bay of San Diego to the northern limit of the bay of San Francisco, each one making a little garden spot in the uncultivated waste. They founded no towns and built no cities. These missions in the height of their prosperity contained 24,000 Indian neophytes, possessing several hundred thousand cattle, 150,000

sheep, and 10,000 horses, and harvesting annually about 75,000 bushels of grain. Their decadence began when they were secularized by the act of the Mexican Congress, and that decline has not been arrested to this day. In the solitary places near where the fathers wrought there are now flourishing towns and cities, and the picturesque ruins of these old missions are among the treasures of the land.

The new era in the history of California began on July 7, 1846, when the American flag was hoisted at Monterey by Commodore Sloat. The discovery of gold followed on January 19, 1848, a month before the treaty of Guadalupe Hidalgo was signed and five months before Americans had acquired their title to California. Henceforth there were to be a new people, new laws, and new institutions. A few months after the discovery of gold 20,000 pioneers started on the long overland journey from the banks of the Missouri to California. Five thousand fell by the way through disease and hardships or were slaughtered by Indians. Scarcely less than 20,000 went by water, either around cape Horn or by way of the isthmus of Panama. In a few months 100,000 Argonauts were in California. Twenty-five years after that date $1,000,000,000 of gold had been taken out of the mines of the state. A stream of gold was poured into the Federal Treasury during the civil war, and there was another blessed outflow into the treasury of the sanitary commission for the relief of friend and foe alike, of the Gray as well as of the Blue.

For the first twenty years in the history of California the only mode of transportation after leaving the navigable rivers and the coast, aside from walking, was by stagecoach, wagon, pack-mules, and broncho horses. In Sacramento and Marysville, the two principal steamboat landings, it was a daily occurrence to have depart at break of day fifty or more stagecoaches and wagons loaded with passengers bound for the different mining towns and camps in the foothills and mountains. The return stages were so scheduled that they arrived back late in the afternoon or evening, and, with fresh exchange of horses, would be ready to leave again the following morning.

The early stage-driver in California was perhaps the most unique and was certainly one of the most important personages in the community. His social standing and influence were rated in about the following ratio: For a two-horse stage-driver to those of the sheriff; a four-horse stage-driver to a member of the legislature; a six-horse stage-driver to a mayor or governor,

while the driver of an eight-horse stagecoach upon a popular route through several flourishing mining camps would not have surrendered his place, with its influence and dignity, for a seat in either house of Congress. The teamster also was a very important personage, and the driver of an eight- or ten-bell mule team, with a single line, considered his position and importance quite equal to those of the superintendent of a railroad. I speak advisedly, for I have been honored with the experience.

Many of the richest mining camps could be reached only by long and circuitous routes, following up the forks and branches of rivers and creeks or over pathless hills and mountains. There being no roads or trails, the only manner in which supplies of provisions, clothing, and tools could be sent into the camp was upon pack-mules. These animals were loaded down with from 250 to 400 pounds of freight, which they carried upon their backs with apparent ease, crawling around steep points, over sliding earth and rock, where it seemed almost impossible for a man to walk. The pack-trains numbered from 50 to 100 mules in a train, each one in a single file, following the "bell leader," which was usually a broken-down, white horse that carried no load, and was directed by the owner of the pack-train, who also had a half-dozen or more Mexican vaqueros to assist in loading and unloading the mules; these brought up the rear of the caravan and saw that none of the train stopped by the way. Arrived at its destination, the cargo of freight was delivered at the mining camps, and the return train took back to the valley letters for the dear ones far away and gold dust to the merchants to pay for the merchandise and freight.

But no prosperous state was ever built over gold and silver mines. These were only a single element of future prosperity. The Argonaut had not come to build, but to find treasure for another and, as he thought, a better land; but these men were unconsciously making ready for the new commonwealth. Civilization could not survive without the state. There must be law and order, security for life and property. There must be organized society, or there would be chaos. Then the pioneers became builders. The bad element must be restrained and the good must have protection. There could be no permanent society without homes. California was no longer a barren land. Pioneers here and there had cultivated a few acres as a sort of heartsease. They had begun to make places beautiful as the garden of the gods. The land seemed to look up and smile when

touched by the various implements of cultivation. There was verdure in the desert. Wheat was no longer brought from Chili for bread. The wheat-fields of California began to wave to the morning and evening breeze.

The discovery of the agricultural capabilities of California was greater than the discovery of gold. Men ceased to talk about a worthless country. The land was vital with the elements of hidden fertility. There came a day when six hundred ships were not enough to carry the surplus wheat crop of the state to foreign lands. The whole country from not producing sufficient to feed 100,000 Argonauts at home was now producing enough to feed more than a million people abroad, and the capacity of the state today is sufficient to sustain ten millions.

Nor has the mineral industry become obsolete. If the testimony of mining experts is to be taken, there is more gold in the placers and quartz mines of the state than all that has ever been taken out; but the products of agriculture, of which there was once no promise, have annually for more than ten years past exceeded in value one hundred million dollars, although they have as yet reached only the first stage of development, while the annual production of gold and silver amounts to less than twenty million dollars.

But these are not all the marvelous industrial changes that have been wrought. The Mission Fathers adopted a primitive system of agriculture. They selected stations near the ocean, where the moisture was greatest and where there were living streams for artificial irrigation. They cultivated no crops that they could not water when the rains had ceased. They brought the olive and the vine from Spain and naturalized them in their gardens. The orange from Seville also sometimes bloomed and fruited there, but there were no blossoming orchards beyond, and no vineyards ripened the grape under the long summer sun. The native Mexican cared for none of these things; he was content with his jerked beef and his tortillas. Fruit was reserved as the luxury of those who cultivated it in consecrated gardens. It has been recorded that many a pioneer was ready to exchange a silver dollar for an apple. The orchard and the vineyard became a necessity. What was good in the old homestead ought to be good about the new one. Seeds were sent in letters; cuttings and small fruit trees came as the most precious freight of the early steamers by way of the isthmus. Orchards began to blossom in the valleys, and the vine made many little patches

of green on the hillsides. The wild vine was found climbing many a tree in the ravines and along the brooklets of the Coast range, and it could not be otherwise than that better ones would take kindly to the soil and give abundant fruitage. The best were brought from Spain and the wine districts of southern France. The mongrel and foxy grapes that suited eastern palates did not win any place in the viticulture of the state. The motto of the Californian everywhere is, "Get the best." After the vineyards of Spain and France had been laid under contribution, princely Tokays and mellow Muscats, with more than twenty other semitropical varieties, began to crowd the home markets. The wine grape climbed the hills and made the claret that was sold under a French label to thousands of eastern consumers. Eighteen million gallons of wine were the product of a single year. Grapes from these vineyards were shipped to every large city of the Union. More than 150,000 acres are now covered with vines in California and the average product for an acre is nearly double the average product of the vineyards of France and Spain. For many large areas the average product is 12,000 pounds an acre, while in special instances the product reaches 20,000 pounds per acre. Beyond all other states of the Union, California is the land of the vine. More than two thirds of the arable land of the state is suitable for viticulture and other fruit culture. There is more land in this one state suitable for the production of raisin grapes than there is adapted to that culture in Spain. When the Muscat began to hang in golden clusters and to turn into raisins on the vines, there was the first suggestion of the great raisin crop that could ultimately supply every market of this country. That the raisin product now falls short of this is because of the keen competition with the crop of Spain, that is produced for less than one-half the outlay for labor that the same production costs in California; but layer for layer and box for box, these domestic pretenders challenge for quality the best in the world. A small industry became a great one by beneficent protection. More is the pity that any part of it should have been withdrawn until these pioneers had fought out the battle for every home market in the land. The raisin product of the state last year was not less than 34,000,000 pounds. Not only is California golden-sunbeled, but the very sun in the heavens turns her fruits into gold.

Such a miracle of transformation was wrought in southern California as had not been witnessed beyond her borders. The

dry land that had become dust under the hoofs of famishing cattle took on perpetual verdure when the streams were trailed over it, and the orange blossomed and fruited under a semi-tropical sun. Towns sprang up and cities were built largely from the proceeds of this citrus industry. Water was impounded in the mountains or was recovered from sunken streams in the plains. The desert became more than a garden. A great citrus product soon to rival that of Florida was the promise of the future. How has it been fulfilled? More than 8,000 carloads of oranges were shipped overland as the product of the season of 1894–'95. Not less than 14,000 acres have been planted with lemon trees, with the certainty that when the maximum of this branch of citrus culture shall have been reached, this fruit will compete for the first place in all the leading home markets of the United States. Of deciduous fruits altogether 4,435 carloads were shipped overland in 1895.

The olive took kindly to the soil. There was, in fact, no product of Spain or of any other country about the Mediterranean that could not be duplicated in California. The fig ripens as it does about the borders of the Adriatic, while of prunes more than 32,000,000 pounds represent the annual production of the state. With wine to make his heart glad, oil to make his face to shine, and honey to sweeten his lips, the Californian may speak with enthusiasm of all this wealth of resources. There there is $100,000,000 invested in the dairies of the state, and 40,000,000 pounds or more represents the beet-sugar product of the state for the season of 1894–'95—an amount larger than the aggregate production of all the rest of the country.

Passing from these details of production, it remains to be noted that California is the most picturesque state in the Union. This wealth of scenery can never be obscured. There is the great Sierra range stretching along the eastern boundary for 500 miles, having a width of 70 miles and summits ranging from 7,000 to more than 14,000 feet. Nineteen of these mountain peaks rise to the height of 10,000 feet, and seven of them rise still higher, until mount Whitney wears the crown, rising into the heavens to the height of 14,898 feet. Some of these summits are still warm with volcanic heat. There they stand, white-hooded, with glaciers moving and grinding along their flanks, as if a thousand years were but as yesterday, letting loose the mountain streams that go singing down to the sea. There is the divine sculpture of the rocks, the lakes that mirror these eternal ramparts, the

lower mail boat ship navigation, and the lesson is forever a very

fir tree with its plume, clean and satisfactory, it was the ideal of

to picture for it a few days. There are the colors more plainly than

those of Lebanon, and places that were dusty pink flecked with bright

before the first winter rains had set foot upon the arid land.

How little of all the treasure of natural wealth can be sacrificed

by human eyes appraised! Hardly can a day pass but some human

is born with a female. There is the great sandy desert, free

from dust, with pure water flowing out of the granite, and its

not lost solitary, but are rich in moral and material life. I was

of curves and contours. There the mangrove is unfolding its petals

as the great plant, red as blood, springs in a day to reach only

with its tops to bowls with a combination for rain. There, Nine

of a wave is lashed of the sea, to make Tia Juana and Ensenada

by and 1,500 feet deep and more than five thousand lakelets

mirror the low mountains that rise above them. Here

are the great reservoirs that send their waters down to form the

the lost valleys below. More than 4,000,000 acres of land are

great towers that are held in place by these great forms, so

that there is neither washing away nor withering drought.

of the world. From the ruins of the earth he manages to see the

swift sunrise of Venus to, which no artist can paint as he

gets one splendid glimpse. They will look up to the mighty

they are set at last well by the plant men if the soil be suit-

able

conditions which they require and take on the rich color of the earth and fade above it and, in fact, demand the presence on either side of water, or whether the trees have planted in extensive groves or small patches together with natural vegetation to give the effect of the world. Cathedral spires and domes are there for the worship and a million towers are erected for commerce. Out of the valley in a rude way he will come upon groves of redwood the largest and which he will find by actual measurement to be 300 feet high and more than 20 feet in diameter. Always to the east rise the great mountain ranges of snow-capped peaks, 14,442 feet high where not there as a great white

seems as far above as the earth is below.

Nor does the wealth of the prospect end here. The rocky

the Coast range that stands between the great valleys and the ocean spills here and there, but as a rule is covered with the stern

for hundreds of miles. From part of the way there is a view

coast range between the mountains and the sea. Santa Cruz,

Monterey, and Santa Barbara present a series of low ranges and are also separated on the Pacific coast for quite a distance.

Here a range cut and the prime cause of perfect

water that shows up the mountains, in some places to their sum-

mit late in the season to New York and other eastern markets.

It is in the best part of the Coast range extending up from Monterey

bay to the northern border of Monterey county that the

redwood trees and average in size. In the area in which

they flourish the whole way of that the redwood, especially

from, is the best the time to use the redwood

for fuel and for the manufacture of the most valuable

timber in the California market. It has a peculiar grain of

straight transparent color of the white cedar, but is lighter and

stronger than any variety of fir and is, which is

the best timber for the redwood species, the

redwood, which is from Monterey to the north

and the Santa Cruz mountains of from 1,000

to 6,000 feet. These redwood trees frequently attain the elevation

of 200 feet and a diameter of from 10 to 12 feet. The

bark is reddish. Timber of the redwood

yielding from 100,000 to 200,000 feet, or a full

county. One of the redwood trees, known as the Fremont tree, in the grove near Santa Cruz, is 275 feet high and is 19 feet in diameter six feet above the ground. In the hollow of this tree a family some years ago found a comfortable residence for a whole winter. It was at or near this grove that Fremont encamped before the conquest of California had been fully made. This great timber district is within the humid belt of California, and all the picturesque valleys that extend along the base of these wooded mountains have a network of living streams that find their way to the sea. The valleys are dotted with beautiful towns and the landscape is a succession of vineyards and orchards. The redwood, besides its extensive use for the interior finish of houses, is everywhere admired for its natural color tones and is now in constantly increasing demand for ornamental use. The pine and the fir tree, so abundant in California, are denizens of many countries, but the redwood makes here the one exclusive home of its kind in the world.

The Sierra and the parallel Coast Range inclose the great and extensive valley of the San Joaquin and the Sacramento, 300 miles long and with a breadth of about 40 miles, making an aggregate area of about 14,000 square miles. Thirty-five years ago the greater part of the land in the San Joaquin valley could have been bought at $1.25 an acre. Twelve years ago there were thousands of acres which the Government had offered at that minimum price, but found no buyers. The parched and desolate valley lay there at the base of the mighty Sierra, adown which the mountain streams descended, yet made no fruitful fields. To-day there are flourishing cities and towns, vineyards and orchards, and great wheat fields. From this valley enough raisins were produced this year to supply two-thirds of the consumption of the whole country. From these and the irrigated valleys 9,000 carloads of oranges and 400,000 cases of tomatoes were this season go forward to Eastern markets. Add to this product not less than 40,000 tons of raisins, and we come to see the relation of all the wealth of production of the great mountain ranges which send their streams down to fertilize this great valley. From the hot plains we look up to these snow-clad mountains and know that the reservoirs were filled, and that the winter gales that sing in the tops of the fir trees and smite the giant sequoias, but serve best to make eternal spring in the valley below. The San Joaquin from the south and the Sacramento from the

[illegible]
miles long and averaging 8 miles in breadth. These great [illegible]
nearest companions of the world.

There is one other particular in which the natural wealth of California surpasses that of any other state. There are more than one hundred mineral springs that together possess all the medicinal qualities that are found in the most notable mineral springs of Europe. Hardly more than half of the whole number that are known to exist in the state have ever had any scientific description. All known minerals that have any healing qualities are held in solution in these waters. Some of these springs have more than local fame for their curative effects. Sulphur, iron, arsenic, and soda are sometimes found in a single group of springs, as at the geysers, where the waters boil and seethe and roar, sending up clouds of steam day and night, as if after the great volcanic forces had shaped the land nature was preserving them for the entertainment of tourists and strangers. Wherever one may go, in all the length and breadth of the state, the scenes of striking pictures are endless. Nothing is there out of significance; nothing, from the winter bloom of gardens, with all the affluence of color and perfume, to the mountain tops that are tipped with gold and purple as the sun sinks into the Pacific.

In one other particular California has greater natural wealth than any other state. Not elsewhere in all the Union are there so many climates. No newcomer can ever get used to the [illegible] of this mystery. He will read of trains delayed by snow-drifts in the mountains, and on the same page of almonds and orange orchards in bloom; of [illegible] that is cut out in [illegible] [illegible] heat to some other place; of men in overcoats in San Francisco in July, and of the mercury that has gone up to 100 degrees in [illegible]

[illegible]

[illegible]

By Dr. N. S. Shaler,

Professor of Geology in Harvard University and Dean of the Lawrence Scientific School.

The old view that the earth was first fitted and that on it were all [illegible] to hold "for aye" has gone the way of many ancient opinions. In every region which geologists have investigated they have had occasion to note numerous and profound alterations in the form of the surface which have taken place since man has occupied the earth. They have come to recognize the fact that man has [illegible]

[illegible]

with the course of nature the operation of many forces has been greatly increased in energy. This understanding has extended beyond the class of special students of earth phenomena. We find, indeed, Marsh's great essay as to the influence of man on ter- [illegible]

[illegible]

from the standpoint of the historian. So far as I am aware no geologist has yet undertaken to consider this matter with refer- [illegible]

[illegible]

I therefore propose to take up the processes of land erosion from the point of view of the geologist, and to trace the influence of man's actions upon the formation and preservation of the soil. In the treatment of this subject we shall be led into that important but as yet unrecognized branch of national economy which relates to the preservation of the [illegible] values of our [illegible] countries.

In dealing with any group of geological features, it is well to consider at the outset the origin and mode of application of the energy that has served to give them shape. We may therefore begin our inquiry with a brief account of the forces which operate in the processes of erosion. So far as regards their origin these forces are essentially simple. They all substantially depend upon the solar radiation. Only secondarily and in a very unimportant way are they due to such frictional action [illegible] to the attractions of the sun and moon, which give rise to the tides. The average amount of heat received by a square foot of the earth's

surface only a sufficient to lift a pound of matter to a height of many thousand feet. If all the heat could be converted into dynamic energy and applied to raising such a mass, it would be measured, the effect would be trifling in the economy of nature. It is likely that a process of interchange would go on at the rate of several inches annually for the earth, but the work is so occupied that only a small part of the energy developed in the process which is employed at work up for the greater portion is given off, in ways that would all have to be studied upon other grounds.

We shall now consider the ways in which encroachments upon an area, and thus be led to see how it may be applied to such work. When the tide flows over shores or beaches, somewhere near one-fifth thereof is covered directly intercepted by the atmosphere, and does not penetrate the

space. Of that which comes to what is commonly called the

radiations into the realms of space. If the air permitted the egress of heat as easily as it does the ingress of that form of radiation it would never acquire the relatively high and

for that work of creation which, as we shall see hereafter, is intimately associated with the existence of all processes of steve-

lute of space, or some but not degree to how much the fluctuations tended. During, however, to a certain extent of the annual loss, the surface is protected by the covering the annular atmosphere, but upon them would produce of heat a little more than the amount

annoying. It is to a certain way a compensation to retain a temperature

perature. The difference of a general warmer state than that of the air. In the subsequent chapters of atlants we are now about to enter of the processes which effect these

Owing to the want of, with the small map given to be found and sea, the atmosphere next to the surface is only heated a little by experiment. This peculiar

nature, applicable to dust-storms, waterspouts, cyclones, or

temporary and migratory characters of the surrounding movement

[illegible]

[illegible] ately arranged towards the tropical zone. Whether these [illegible] are great permanent tropical [illegible], their effect is to [illegible] the air [illegible]. The [illegible] of the atmosphere are con- [illegible] month. These winds, of sufficient energy to have distinct geological value in a direct or indirect way, appear to be constantly [illegible] during the long winter nights in the realm about either pole.

The simplest geological work of the winds is that which is [illegible] by their friction upon the water surfaces of the earth. For our purpose the [illegible] result of this friction is the formation of waves or tidal [illegible] of water, in which are stored the energy which the winds expended in their making. In their greater form these waves may have a length of several miles, a width of a thousand feet or more, and a height from trough to crest of fifty or sixty feet. Such a wave may store more energy than can be applied at one time by the [illegible] greatest [illegible]. Conveying their power from a [illegible] storm wind, these waves can run on for hundreds of miles after they have passed beyond the field of air which set them in motion. So long as the waves move over a deep sea they have no geological value. The greater part of them die out, generally converting the energy which they represent into heat that is given to the water or to the air. When, however, the surges enter a part of the sea which is relatively shallow, they begin to do their work. In a depth of [illegible] feet the higher waves drag a little on the bottom, brushing the sea floor lightly in a manner that may move the finer sediment. At a depth of two [illegible], [illegible] toward the shore and with each [illegible] step [illegible] the wave rises in the wall of the surf; the final blow comes [illegible] like the fury of an avalanche, which [illegible] before it everything that is not closely knit to the surface over which it is moving.

As the wave comes into shallow water, and in proportion to [illegible]

[illegible] the [illegible] of the waves due to [illegible]

The loss is shown to be caused by the increase in the height of a wave as it approaches the shoreline and the steepening of its front. A good measure of the height to which a breaker

will [illegible] in deeper water. These two series of the waves are thus known together, so that at the crest of the wave in relatively [illegible]. For all this, however, the wave which at [illegible]—that is, when it has top, or part least held back by the friction on the bottom, shoots over the base and falls in the current nature of the sea—probably never exceeds twenty feet in height and the energy left in the carrying water may be expected at least to [illegible] it as well as by the greater weight of the open sea.

When the wave observes its finishing stroke in the surf line and [illegible] each [illegible], the manner in which its energy is applied [illegible] largely [illegible]. The falling mass of water [illegible] a

[illegible] effect; but when, as is often the case, the beach is covered with loose stones, these fragments are driven about in a

[illegible] these fragments which [illegible] or wear [illegible] the upper edge of the beach is [illegible] and [illegible] is generally the case along rock bound shores, the swash and [illegible] waves which gather inside the [illegible] of the surf reach the [illegible] with great force to [illegible] the [illegible] of the [illegible].

Although the waves have in the cases last [illegible] enough energy to be used to do the work of [illegible] to be [illegible] to accomplish a great deal of erosion. Wherever the shore [illegible] [illegible] or along the shelf to overcome [illegible] to [illegible] the weight of the mass which [illegible] to [illegible] [illegible] [illegible] to the beach [illegible] of the [illegible].

Wherever the level of sea and land remains for a considerable time constant and the shore is not protected by sand beaches, the sea cuts a notch or bench into the rocks. Even a few centuries will suffice to make this bench a noticeable feature of the sea front. A single geological period may serve to bring it to a width of one or many miles. In general, however, the frequent, we may say the incessant, changes of level place the shore now here and now there on the land surface and so distribute the effect of the marine benching over an area the width of which varies with the steepness of the slope from the interior to the coast.

It is not as yet possible for us to estimate the value of this [illegible] has been disposed to give it less importance than they did in the earlier stages of the science. In my opinion they have seriously underestimated its importance. That it is of much value [illegible] the shores in very recent times. To limit ourselves to coasts [illegible] the United States, we may instance the southern borders of the islands of eastern Massachusetts, which since the settlement of [illegible] years has amounted to five or six feet. On the corresponding shore of Martha's Vineyard the recession during the last forty years (as has been shown by the surveys of Assistant H. L. [illegible] of three feet per annum. It is probable that the gain of the sea on this part of the coast during the three centuries since the [illegible]

On ordinary rock shores the rate of wearing is relatively slow and it is exceedingly variable in amount, but where the waves have a fair chance to assail the land it is always considerable. Al- [illegible] we must reckon the gain of the sea at a mean of two feet per century. Computing at ten thousand years, the time that has elapsed since the ice-sheet of the last glacial period passed from these shores, the total amount of the coast erosion should average two hundred feet. During a period of one hundred thousand years—a very brief age in the history of the world—the sea should have worked its way in more than a third of a [illegible]

be reckoned at less than two to three millions of years ago, the recession of the shore, due to the action of the waves, may fairly be estimated at several miles. Taking all the coast line on the eastern border of the United States into consideration, we see that the sand beaches, owing to their singular endurance of wave-action, a feature I have discussed elsewhere, have an important restraining effect on the process of marine erosion. Making allowance for this protective work, it remains clear that the effect of ocean waves is to wear back the shores to a considerable extent, and that at a rate which in a geological sense may be termed rapid.

As geologists find but few shores bordered by sea-cut benches cut in the hard rocks, they have generally underestimated the value of wave-work, because in forming their opinion they have neglected the important fact that the continents are constantly changing their positions in relation to the sea level. Every st[illegible] the shore lands are ceaselessly and at times suddenly moving upward or downward. Even those coasts which now appear to

sinking or rising. The result of these perpetual swayings of the coastlines is to distribute the cutting action of the waves over a wide zone, extending along the coast of the great lands from a level much below that of the present shores to a position far higher than that which they now occupy. In some instances, where the sea has continued to remain for a long time in contact with the land on one horizontal plane, we note the existence of broad shelves of rock extending outward from the sea-cliffs, sometimes to the distance of a mile or more. Thus on the coast of Yorkshire, from Whitby southward, a sea-cut bench, with its surface just above low tide, extends seaward from the foot of the towering cliffs for an average distance of more than a mile, attesting in a distinct manner the cutting power of the sea. In general, we may say of the eastern coasts of North America that the evidences of marine work are visible to a height of several hundred feet above the plane of the ocean, and that there is good reason to believe that such cutting work has been done on much of the slope which now lies below the sea. When by the uplifting of the land ancient sea benches are carried above the limits of wave-action they are quickly worn away by the processes of erosion which are proper to the land. When such benches are lowered beneath the ocean they are soon covered by

[illegible]

Above the gate to the east of North America, from South Carolina to

have been worn down to their present level by the gradual advance of the

eastward we have the yet older ridges of the Blue

[illegible]

to-day, they are relatively steadfast. They are covered

[illegible]

[illegible] of their rocks.

Looked at from the point of view of practical interests the

We note that even a hasty trip at any weight changes of considerable moment to mankind. Wherever the shore is bordered by very hard rocks or walled-in by sand hummocks, the [illegible] by which the land is stripped away and its debris carried into the sea are very slow; the disruption of the coastline is a long period, and there is a distinct effect on the development of man. Where, however, the coasts are of soft rocks, it is quite often a rapid, and at many stages of the history of their shore lines. This, at the time of [illegible] when a new people got on the southern shores of Newfoundland, [illegible] likely to [illegible] a [illegible] of two or three thousand years,

[illegible] flood of the sea [illegible] which stretch far [illegible] eastward of that island, shallows which seem to mark the [illegible] of

[illegible] flattened down by the sea.

[illegible]

...ed by fine sand or mud two or three centuries to come. The meadow...

...ntal rocks, and also the work of a rapid through locally varia-

...es of fresh-water capacity has been sufficient to clear mash in a

...ficial results of the waves and the currents which they would produce or by a combination of subsidence and wave-action, there seems to be no effective means of prevention. The sight of the engineer, applied at great cost, may arrest or delay the loss at points where the safety of harbors or towns is involved, but

...to protect the sea margin from wasting where the inhabitants are ready to make agreement any kind. Our own coasts, particularly that of New Jersey, are strewn with wrecks which mark the

...ture waves. At certain points in eastern Massachusetts I have found it worth while to build walls of cobbles on the sea-shore where the waves broke, and was glad to find that a thickness of five cobbles would keep the sea from the huge boulders drawn

...the waves breaking on the artificial beach are tended from the cliffs. These by saving the sea-cliffs would for a time be kept from their ravages. Where the waves do not attack the coast line with a height of more than five feet, the inexpensive barrier appears to be very serviceable, but on the more open shores may avail it that could without great cost be placed on the sea margin would be beneficial and rapidly warn to many lots. For the protection of the precious sand, that most of all the

...more rapid destruction which is held about by the down-

the surface of the lands. There, owing to the fact that the air is more or less deeply cooled, the precipitation of the water vapor is more favored, and the proportion of rainfall is usually greater than it is upon the surface of the ocean. From vapor the land, the precipitated water comes down in one or another of three forms—as dew, as rain, or as snow. The dew, though it has much economic importance because of its relation to plant life, has only indirect value in the problem of land erosion. It serves to diminish this wearing by favoring in the dry seasons the development of a mat of vegetation which in the period of rains protects the earth in a very effective way from the temporary streams which gather during heavy showers. The importance of this form of precipitation is great, but it is so limited that we may, with this brief statement, dismiss it.

The next important form of falling water is rain. In this mode of precipitation we usually find the fluid descending from a considerable height in the form of drops of varied bulk, averaging [illegible]

on their way to the earth, though their momentum is much diminished by the friction they encounter in passing through [illegible]

on recently tilled earth, we readily see certain important consequences arising from the immediate assault of the rain. As soon as the soil is moistened, each stroke acts to break up the clods, [illegible]

readily borne away by the rills which, if the shower be heavy, quickly form in such numbers as to interlace the surface. In a few moments these little streams, at first obscure, gather into distinct rills, which, with quickly swinging curves, carve out a model of a new drainage system. In the course of an hour of very rapid downfall a bare, plowed field, on a declivity of not more than five feet in the hundred, or less than the average slope of land, may have an average of one-tenth of an inch of its surface removed to the channels of the streams which drain it. Commonly, after a heavy rain, it may be noted on a field which has been plowed and rolled that here and there a small bit of stone or a potsherd lies on top of a little earthen column. We see at once that the natural roof has protected the earth beneath and caused it to be left behind in the process of erosion which has overtaken the soil of the neighboring surface.

[illegible] natural [illegible] of vegetation and on a [illegible] which as [illegible] will show the [illegible] influence of the vegetation will in the [illegible] no erosive action whatever. In the forests the [illegible] of occupied vegetation is in most cases [illegible] to [illegible] [illegible] [illegible] how ever weak and in such a [illegible] that it removes not a [illegible] of the soil. On the mesa we the [illegible] of the water is more [illegible]

[illegible] such at [illegible] break, even when [illegible] into [illegible] [illegible] stream. [illegible] field [illegible] [illegible] have made [illegible] [illegible] [illegible] an hour, a rate [illegible] [illegible] called torrential, may be carried [illegible] [illegible] to a [illegible] without [illegible] by [illegible] [illegible]

If [illegible] no [illegible] [illegible] must [illegible] would [illegible] [illegible] [illegible] [illegible] serve [illegible] [illegible] which they depart from the rapid degradation [illegible] [illegible] [illegible] [illegible] [illegible] [illegible] afford to [illegible] soil on [illegible] [illegible] [illegible] [illegible] [illegible] our attention to the further history of the rainwater

[illegible] the [illegible]

THE NANSEN POLAR EXPEDITION*

SPECIAL REPORT OF THE HON. ERNEST A. MAN

United States Consul at Bergen

On the 17th day of June, 1893, as some of the members of the [illegible] Land, were looking out over the sea they discovered a white figure

and dogs towards the Pole. In a sledge near [illegible] was Dr Nansen's companion, Lieutenant Johansen

with dogs. Dr Nansen's return home. While Nansen did not

to be of value to the scientific world and of great public interest a second [illegible] efforts in the same direction.

[illegible] with a company of thirteen men, left Varna, Nor-

[illegible]

[illegible] up on to [illegible] ice-floes, but finding that owing to the shoals and rocks near [illegible] of the season they would probably

took a northerly course into the open Arctic ocean until September 22, when in 78° 50' north latitude and 133° 37' east

[illegible] easterly course, according to the plan laid out by Nansen, and by which he hoped to drift near or over the Pole, as was

[illegible] equal to reached the eastern coast of Greenland.

and agreed [illegible] the weather they were to [illegible]

* This report, translated from Bergen Dagblad, has been courteously placed at the disposal of the National Geographic Society by Hon. W. W. Rockhill, retiring

[illegible] would drift to the east would depend, Nansen determined that the best line of action to take would be to steer due north as long as possible, in the hope that the ship might be carried near the Pole. If she should not reach the Pole, at any rate she would be sure to get into the unknown area to the north of Spitzbergen, and by this means solve an important problem.

Having given the most careful consideration to the matter, Nansen decided that it was at the end of his third winter—the winter of 1892-93—that he would make his attempt to reach the Pole. He had two vessels in the course of construction at the time, but only one was ready by the spring of 1893. This vessel was the *Fram*, which was specially built for the purpose by Colin Archer, of Larvik, in Norway, and was strengthened by Dr Nansen's own suggestions. She was launched on the 26th of March, 1892, and was fitted out at the Lysaker Wharf, near Christiania. She took with her 12 men, 2 sledges, 2 kayaks or canvas-covered canoes, food for three years, dogs, and provisions for fourteen months. From the 14th of March until the end of April they struggled onwards, making their way on an average of about one mile per hour, sometimes northerly or southerly with [illegible] but generally in a north-easterly direction. It was wearisome work to drag the heavy sledges over the ice-hummocks, and with the temperature at 40° below zero, Fahrenheit.

On April 7th and 8th they were labouring through an [illegible], there was no prospect of making any progress that day. They were then at 84° 4′ north latitude. Dr Nansen put on his snow-shoes and took a last reconnaissance to see if there was any open water ahead. As far as the eye could reach, huge blocks of ice were piled before the wind, with no land or any indication of the end of the ice-pack. It was apparent to Nansen that he and his companions, with the rate of drift against them, were rapidly decreasing, they had proceeded as far as it was safe to go, and no longer doubted that they would abort their return journey, taking a westerly course towards Franz Josef Land, some [illegible] miles away, where they knew there was a depôt of provisions.

They set off on this day of April, 1893, at 1 p.m. The ice was very heavy, and progress was slow. Nansen and Johansen, with their sledges and kayaks, went on ahead, and picked out the best route, but they [illegible] were [illegible] long distances on their snow-shoes, and hence drift [illegible]

the external rudder back to the starboard. Toward the last of June they came to out to prepare a sort of camp and wait for the ice to break up a little more. The ice-foot was given up and they

[illegible] but on the 2nd of July they pushed on again with headway [illegible] toward land, which they sighted the next day, July [illegible] at 81° north latitude.

At that time of the year the sea was comparatively broken up, and as it was in the boats they were obliged to travel

[illegible] to the time was occupied with [illegible] the west of which they found open water, a channel that they ran in their way in a westerly and southwesterly direction until August 26th, at 81° 17′ north latitude and about 58° east longitude. [illegible] at this point—Franz Josef Land—whom The Navy's party had left a year earlier to prepare them selves for spending the dark winter months, as it was too late to continue the journey to the southward. The

[illegible] the [illegible] and [illegible] the Polaris seen without a roof to cover them, even without fuel which they had left in order to have a little more room for the important personnel.

The hut they put up was constructed of stone and turf, covered with walrus skins, was twelve feet long and six feet wide, with a stone bench on each side. [illegible] they spent a very comfortable, though cramped, winter. Last days and hours [illegible] before they found land. They

for [illegible] gave out [illegible] and to kill the weakest, day after day, in order to feed the rest of the party.

[illegible] this terrible winter event was their separation—in fact, it was two parties [illegible] during the year a considerable [illegible] apart. The hut was used by the [illegible], while a large house was constructed out of the material of the ship. They were [illegible] to make their way [illegible] to Lincoln Bay, [illegible] with a supply of [illegible] and a [illegible] of the ship [illegible] to go northward to try and [illegible] the [illegible] party [illegible] southward.

[illegible] set out for Spitzbergen. On May 23d they came to open

[illegible]

with open water spreading out to the north and west of it, but they succeeded in getting over the ice to the west coast, into a broad [illegible]. When they reached the west coast of the island they found the open sea to the westward. It was a fine struggle up over the ice of the coast of the island to the point where the Jackson-Harmsworth expedition, which had spent the winter of 1896-97, had its headquarters. It was Nansen's turn

[illegible]

Johansen sprang up, and cried "bear hunting." In the meantime he had left the mouth of the [illegible] and had landed. He had

[illegible] They prepared at once to take Johansen and the camping outfit with them to

[illegible] which had carried the two men for so many days. They were made of a frame of bamboo, covered with sealskin. One boat had been made by Nansen and the other by Mogstad, the carpenter on the Fram. They weighed

nearly two tons over, with a burden they were for the power, and as much as I a smaller [illegible] through which to get at the provisions and [illegible] stowed under the boats and were

which had been smoothed over from continuity to keep them

[illegible]

[illegible] the sledges etc. The only cooking utensil was a somewhat primitive, and in the bottom of it were left to remain of the last meal was a [illegible] of seals, [illegible] salt water, the meat of a young walrus, and a [illegible] bones. It is said that

[illegible] Nansen and Johansen as they would [illegible] to the Russian [illegible] [illegible]

of the Arctic Ocean

most practical thing at Vardö, Norway and on the 78th of the same month the *Fram* came steaming into Vardö harbour, their Homeward, and thus the whole expedition was over more on the

without a parallel.

After Nansen left the *Fram* in Captain Sverdrup's charge a great many days, on account of the westerly drift, sometimes very

from which steam seemed almost impossible. Only a few days after Nansen left them, the *Fram* reached her highest latitude, viz. 85° 57′ north

northwards again, and when the ice broke up this summer of 1895 the most energetic efforts were made to free the *Fram* and get her through the vast fields of ice out to open water. This

no more obstacles between her and home port. No one had been ill or suffered during the voyage and not a case of scurvy had occurred. Of course, they missed, and the dreadfulness with

which all had to fight by a feeling of anxiety caused by the ever-changing

ice. The electric light, with its wonderful and constant power,

and we have to thank Sverdrup for turning the capstan and

of latitude. During the *Fram*'s stranding and refitting at

ship, which enable all to exercise as in a gymnasium. Some hours in the

in per week which he how it the use in electricity water shows it a

in the upper regions almost to Polaris itself.

Whose many contend that Nansen's theory of the Gulf Stream flow as across the Polar sea to the east coast of Greenland is correct, there are strong arguments against it, as Sverdrup, who was in command of the *Fram* when she made

practically the whole of the other hand, from a look at the chart showing the entire drift of the *Fram*, there would seem to be a reason in the absolute fact of the *Fram* having been carried

westward and not eastward to the northward of the New Siberian

It is said that Dr Nansen himself has stated that he would be inclined another explanation of that direction it would not be

sudden of the present absence has for a long time

Whatever may be thought of the wisdom and soundness of

the minutest details of their undertakings. The fact of these

well-known leaders of high learning, with the concurrence of

in their labours. In which, no doubt, these will be very helpful to the

investigation, but still false may a very important fact.

CL-CLIFFS ON THE KOWAK RIVER

By Prof. J. C. Cantwell,

Forest Ranger, Government Office, [illegible]

[illegible] quarterly [illegible] [illegible], the [illegible] portion of which lies within the Arctic circle, it [illegible]

During [illegible] of [illegible] it was my good fortune to visit [illegible] and to make a [illegible] of the strata [illegible] the [illegible] [illegible]. Among the many [illegible]

[illegible] a little [illegible] [illegible] a remarkable series of [illegible] observed along the banks of the river at [illegible] and [illegible]. These deposits of ice were first seen by some of [illegible]

[illegible] the interior we still found [illegible] deposits [illegible] in the form of cliffs. [illegible]

[illegible] are found are not all fixed with [illegible], and the [illegible] remarks on these walls are [illegible] [illegible] and [illegible] show beyond question that the water has never reached a [illegible]

At two points [illegible] cliffs [illegible] a [illegible] of over [illegible] feet, and [illegible] found the [illegible] were superposed [illegible] a layer of black, [illegible] and [illegible] of moss, grass, and the characteristic Arctic shrubbery, consisting for the most part of willow, alder and berry bushes, and a dense forest of spruce trees from 30 to 50 feet high and from 4 to 6 inches in diameter.

Where the face of the cliffs was towards the south the upper

great masses of sand trees have been broken out and
in front the stream. We have had strong winds from
the land, so that I think it cannot come from the ice
which would be left as a moraine should be some time after
Europe are a contrast to those of the region where the ice
away from the upper river.

An examination of the bank of the precipitous cliff of North
on the east of the dense undergrowth and the thick carpet of
moss, which covered a little about a foot above the water
was found some 3 yards from the top of the cliff. The water
[illegible] decayed vegetable matter on the bottom. A piece of the
after a few pieces of the same many of vegetable matter
and, when fresh, emitted a very pungent, disagreeable odor.

The country in this region is mostly rolling land, with numerous small lakes all of which empty into the upper rivers. There is a very [illegible] of glacial action
water, and it is not [illegible] the first moraine that we came to was
made [illegible] of [illegible] that any portion of the region.
There is a further object I more particularly [illegible] of
trap, which an examination showed to be a [illegible]
[illegible], with [illegible] horizontal, [illegible]
[illegible]. A short work form to show our stake to each [illegible] of
the [illegible] that I am [illegible] work [illegible] of
the upper river region. The formation of the remarks is now
[illegible] the lower country is, however, a [illegible] with
the water [illegible] and [illegible]

[illegible] A. W. Greely [illegible] the Navy [illegible] Polar Expedi-
[illegible] [illegible] [illegible] [illegible] September 19,
[illegible] [illegible] [illegible] [illegible], but [illegible]
[illegible] exception to [illegible] the [illegible]

RECENT HYDROGRAPHIC WORK

The work of the Division of Hydrography of the United States

[illegible] printed or issued by Congress during the [illegible]

[illegible], 1904, we have—show that a large amount of data of [illegible] or use to the people have been accumulated. The

[illegible] of the Department, and of the Administration. Even [illegible]

[illegible] and being applied [illegible] to the [illegible]

[illegible] character. In particular, the work of Mr [illegible] upon the underground waters of Kansas,

[illegible], upon the [illegible] of underground [illegible],

[illegible] of the [illegible] waters [illegible] by an [illegible] the large [illegible]

[illegible] of the city water works to be [illegible] at once to make [illegible]

[illegible] the [illegible] water has been [illegible], and he has been [illegible]

[illegible] to make [illegible] observations upon the rate of flow and [illegible]

[illegible] of these [illegible] waters. The lack of [illegible]

[illegible] city [illegible] data always [illegible] that the [illegible] of the [illegible]

[illegible] of ground waters by [illegible] so [illegible] a [illegible]

[illegible], but a large amount of detailed work is necessary. The [illegible]

[illegible] of a correct knowledge of this subject can best be [illegible]

[illegible] when it is [illegible] that the [illegible] of a large [illegible]

[illegible] of the most [illegible] [illegible] of the west is [illegible] upon the

The investigations above [illegible] and are, however, but a part [illegible]

[illegible] of the Division of Hydrography. In eastern Nebraska [illegible]

[illegible] is [illegible] part [illegible] of Lincoln and [illegible] Professor Erwin H. [illegible] has carried on a [illegible] [illegible] of the artesian [illegible]

[illegible]; in North Dakota Professor Edward J. Lemmon has been making [illegible] of the water supply of [illegible] and [illegible], in Nebraska Mr. N. H. Darton has been making a [illegible] study of the areal geology of the vicinities of Lincoln

[illegible] regarding the [illegible] of waters, and Professor Erwin H.

particular attention to the artesian conditions in the vicinity of the Mesa de Guaje flowing wells, and in the Rio Grande valley Mr

an examination which I made of all the glaciated areas. About twenty-five short papers are in preparation relating to the

solution of this irrigation or the power for domestic purposes

P. H. N.

MISCELLANEA

The Superintendent of the Coast and Geodetic Survey has organized a magnetic division, of which Prof. L. A. Bauer is chief. The National magnetic survey is frequently mentioned, and more will be sought for upon the Pacific Slope, Hawaii, and the Philippines.

The library of the Naval Observatory has been enriched through the munificence of Mr. Hugh Graham, Montreal, president of the Star, who has presented to it an unbroken set of Nautical Almanacs for voyages from its commencement in 1767 to 1906, inclusive. These 139 volumes cover the world's explorations for nearly half a century and mark the most valuable geographical epoch.

The work of the Coast and Geodetic Survey has been greatly advanced by the recent completion of the magnificent steamer Explorer, which has been engaged in the survey of the Alaskan coast. Her equipment and outfit are the most complete of any vessel in the service, and she is admirably adapted for the work in which she is engaged. She is a steel vessel of 1,800 tons displacement, 235 feet long, 39 feet beam, and 17 feet draft, and has a speed of 14 knots. She is fitted with the most modern appliances for deep-sea sounding, dredging, and hydrographic work, and has a complement of officers and men of 120.

It is proposed to locate on a mountain peak having a commanding view of the land and sea for many miles around it a station for the study of solar phenomena. A very powerful telescope of large aperture will be the principal instrument. The latest and most improved spectroscopic, photographic, and other apparatus will be provided, and the work, from time to time, will be carried on by the most skilled astronomers. In this connection it should be noted that one of the most remarkable manifestations of the power of the human mind is the wonderful development of the art of astronomical instrument making in this country. Among the names of those who have given it their highest support are Alvan G. Clark, Brashear, Ritchey, Hastings, Boyce, Locke, Warner, Swasey, Brashear, Brashear, and many others, any one of which would be a credit to the whole of Europe. The progress of the world depends largely upon the encouragement given to the study of astronomy, and it is to be hoped that the generous spirit of the past will be continued in the future.

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By JUDGE EMORY F. BEST,

ASSISTANT COMMISSIONER OF THE GENERAL LAND OFFICE.

[illegible]